

The Two Column Aerosol Project (TCAP): Update and Preliminary Findings

TCAP Science Team (POC: Larry Berg)



Pacific Northwest
NATIONAL LABORATORY

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Deployment Timeline

June 2012

Surface Deployment Starts AMF1, MAOS

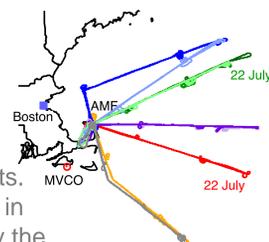
The AMF1 and MAOS were deployed in June of 2012 at the Highlands Center on Cape Cod



July 2012

Aircraft Deployment: Phase 1 DOE G-1 and NASA King Air

The DOE G-1 was equipped to measure particle size distributions, chemical composition, and optical properties. The NASA King Air was equipped with remote sensing instruments. Instruments deployed in both Phase 1 and Phase 2 are indicated in blue. Individual flight tracks flown during Phase 1 are indicated by the various colors. The tracks intersect over the AMF.



First science deployment for:

- Mini-SPLAT—single particle size and composition
- NASA Spectrometers for Sky-Scanning, Sun-Tracking Atmospheric Research (4STAR)
- NASA High Spectral Resolution Lidar (HSRL-2)—Aerosol backscatter, extinction, depolarization, AOD (532 nm); aerosol backscatter, depolarization (1064 nm)
- CU 2D GMAX-DOAS—Aerosol extinction, trace gases

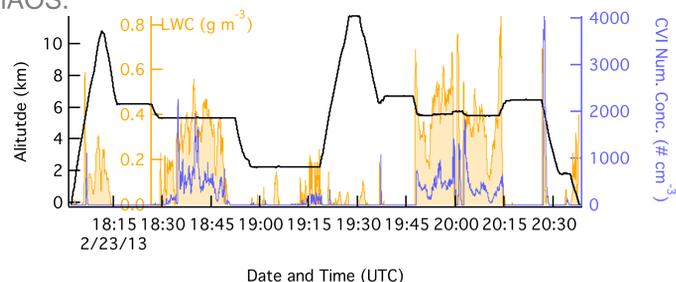


Plus additional state-of-the-art instruments:

- Aerosol Mass Spectrometer—aerosol composition
- SP2—refractory Black Carbon (BC)
- PILS—aerosol composition
- Aerosol optical properties—scattering, absorption, f(RH)
- Aerosol, cloud drop, and precipitation size distributions
- CCN spectrometer
- Research Scanning Polarimeter (RSP)

Aircraft Deployment: Phase 2 DOE G-1

G-1 instrumentation was the same as Phase 1, but with the addition of a counter flow virtual impactor (CVI) inlet for capturing cloud drops and studies of indirect effects. MIT deployed a system to measure chemical composition of CCN at the MAOS.



Cloud/Aerosol Mission: Time series shows aircraft altitude, liquid water content (LWC), and particle number concentration for a special cloud/aerosol mission that included additional passes over the AMF. Note the good correlation between the LWC and the number concentration measured behind the CVI. Other cloud/aerosol missions used a standard flight pattern.

Overarching Goal

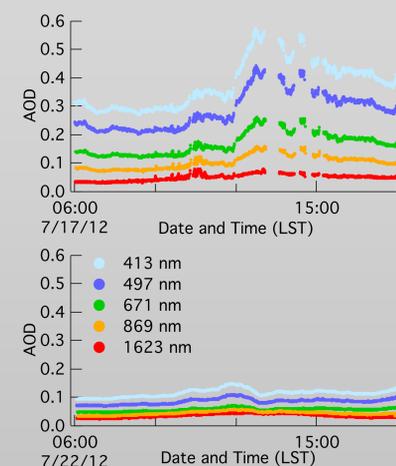
Understand the processes responsible for producing and maintaining aerosol distributions and associated radiative and cloud forcings off the East Coast of North America

Measurement Strategy

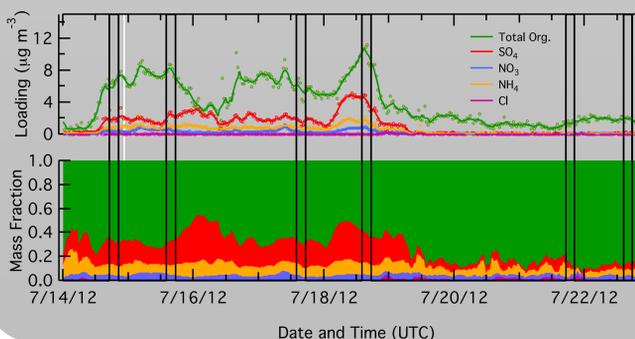
Sample two atmospheric columns, one near the coast and one several hundred kilometers offshore, during multiple seasons in both clear and cloudy conditions.

Phase 1: A Tale of Two Days

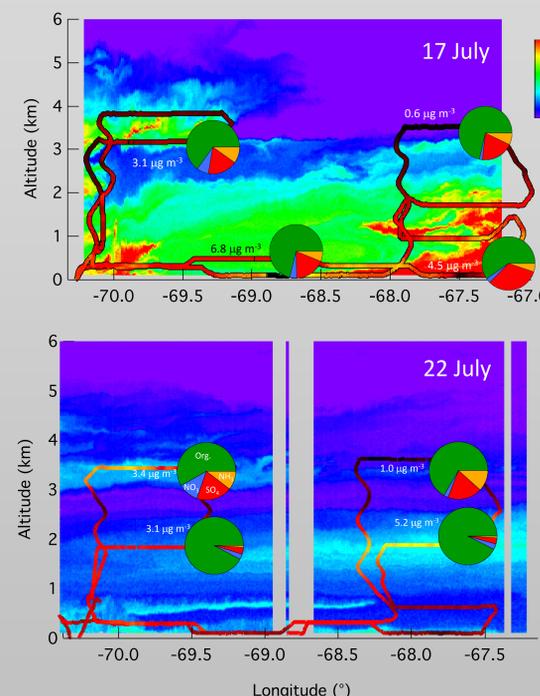
Two clear-sky days have been selected with very different aerosol properties. The wind speed and wind direction were approximately the same on these two days. The flight track on 17 July was designed to sample across the aerosol gradient.



1. AOD: The AOD has been estimated using the MFRSR, with much larger values of AOD occurring on 17 July. Is this due to changes in aerosol loading, composition or both?



3. Backscatter: Aerosol backscatter was measured using the HSRL-2, and is overlaid with aerosol scattering, and particle mass fraction measured with the AMS.



2. Aerosol Composition: The Aerosol Chemical Speciation Monitor (ACSM) deployed at the AMF provides a continuous measure of aerosol composition at the surface. The period from 15-19 July is marked with large loading and relatively large amounts of sulfate compared to 20-23 July. Bars indicate periods when aircraft were aloft.

Summary

TCAP is designed to:

- Improve understanding of cloud-aerosol-radiation interactions, and provide data to improve climate models.
- Provide coordinated deployment of instruments to measure: particle and trace gas chemistry, size distributions, radiation, and cloud properties.

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